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C, O, S, and Sr Isotope Geochemistry and Chemostratigraphy of Ordovician Sediments in the Moyero River Section, Northern Siberian Platform

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Abstract—The $^{87}Sr/^{86}Sr$ ratio in gypsum and limestones of the Ordovician section of the Moyero River decreases from the bottom upward from 0.7091–0.7095 in the Irbukli Formation (Nyaian Regional Stage, ~Lower Ordovician Tremadocian Stage) to 0.7080 in the upper part of the Dzherom Formation (Dolborian Regional Stage, ~Upper Ordovician Katian Stage), which is well consistent with biostratigraphic subdivision of the section and existing concept concerning the strontium isotope evolution of the World Ocean. The most characteristic feature of the carbon isotope curve is decrease of $\delta^{13}C$ values in carbonates from weakly positive values (0.5...1.1‰) in the Irbukli Formation (Nyaian Regional Stage) to sharply negative values (–5.4...–5.8‰) in the middle part of the Kochakan Formation (top of the Kimaian Regional Stage, ~end of the Dapingian–base of the Darriwilian Stage). Increase of $\delta^{18}O$ from 20–22‰ to 26–28‰, the negative correlation of $\delta^{13}C$ and $\delta^{18}O$, and decrease of $\delta^{34}S$ in gypsum from 30–32‰ to 22–24‰ in this interval indicate that the ^{13}C depletion of carbonates was not related to the sulfate reduction and oxidation of organic matter during diagenesis and that the negative $\delta^{13}C$ excursion was of primary nature. The presence of negative $\delta^{13}C$ anomalies at this stratigraphic level in Ordovician sections of the South and North America (Buggish et al., 2003; Edwards and Saltzman, 2014; McLaughlin et al., 2016) indicates the global or subglobal distribution of this event, which was possibly related to the emergence of the oldest ground vegetation. Against the general decrease of $\delta^{13}C$, the lower part of the section reveals three low-amplitude (1–2‰) positive excursions, the position of which in general confirms the existing correlation scheme of the Moyero River section with the international scale. The upper part of the section is characterized by the alternation of low-$\delta^{13}C$ intervals (from –2 to –3‰) and brief positive excursions with amplitude of 0.5–1.3‰. The positive $\delta^{13}C$ excursion terminating the Ordovician section of the Moyero River correlates with the $\delta^{13}C$ excursion in the middle Katian Stage, while the $\delta^{13}C$ excursion in the lower part of the Baksian Regional Stage correlates with the excursion marking the Katian–Sandbian boundary.

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INTRODUCTION

Ordovician rocks occupy a significant part of the Siberian Platform, being second in abundance after Cambrian rocks. Extremely shallow-water epicontinental Ordovician basin was characterized by a complex facies differentiation. Provincialism and low diversity of fauna inhabiting this basin complicate a detailed stratigraphic subdivision of Ordovician sections in the Siberian Platform and their correlation with other regions.

In recent years, carbon and strontium isotope variations in carbonates have been successfully applied in the inter-regional correlations of Ordovician sections. Although variations of these parameters in the Ordovician ocean have not been clarified in detail, numerous studies in different continents (Ainsaar et al., 2010; Azmi et al., 2010; Buggisch et al., 2003; Kaljo et al., 2007; Ludvigson et al., 2004; Munnecke et al., 2011; Bergström et al., 2009; Shilds et al., 2003; Edwards and Saltzman, 2014; Husinec and Bergstrom, 2015; McLaughlin et al., 2016) revealed several positive and negative $\delta^{13}C$ excursions, which could be used as global stratigraphic markers.

The first attempt to compare the Middle–Upper Ordovician rocks of the western part of the Siberian Platform (Kulyumbe and Podkamennaya Tunguska rivers) (Ainsaar et al., 2015) with the reference sections